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Европейская международная программа
«Copernicus»

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Europe's eyes on Earth

Looking at our planet and its environment

For the ultimate benefit of all European citizens

An AgriTech start-up from Belarus demonstrates that societal and economic benefits of Copernicus go beyond the borders of the European Union

1 Middleton in Queensland, Australia - Copernicus Sentinel-1 and Sentinel-2 data (2018) processed by Peter Scarth



Atmosphere



Marine



Land



Climate Change



Security



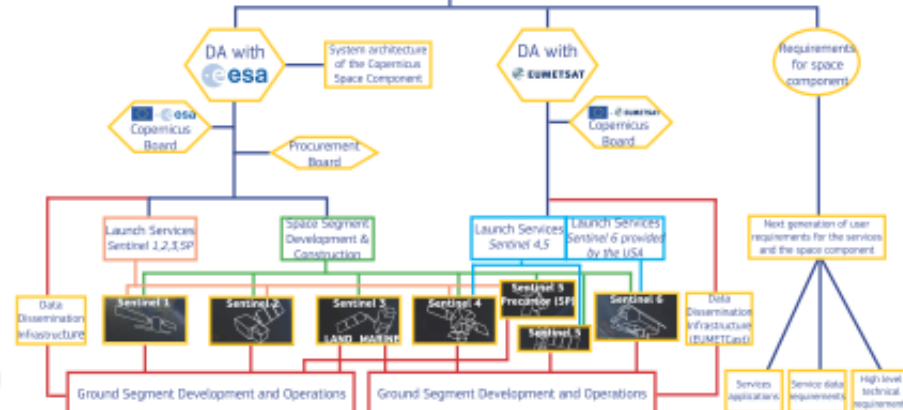
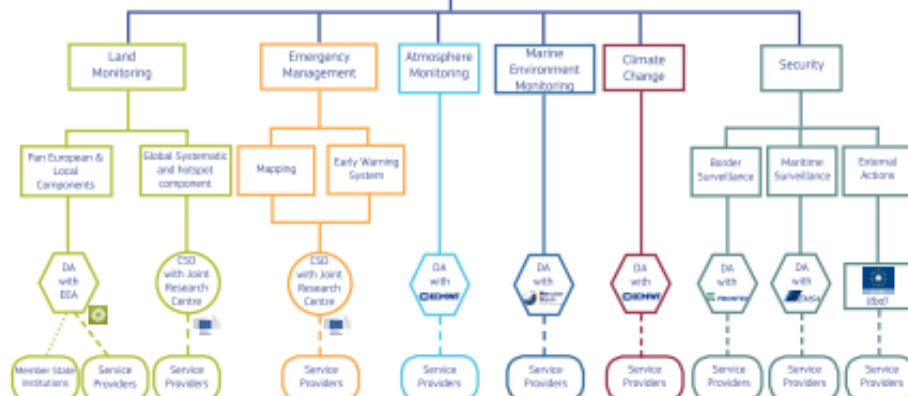
Emergency

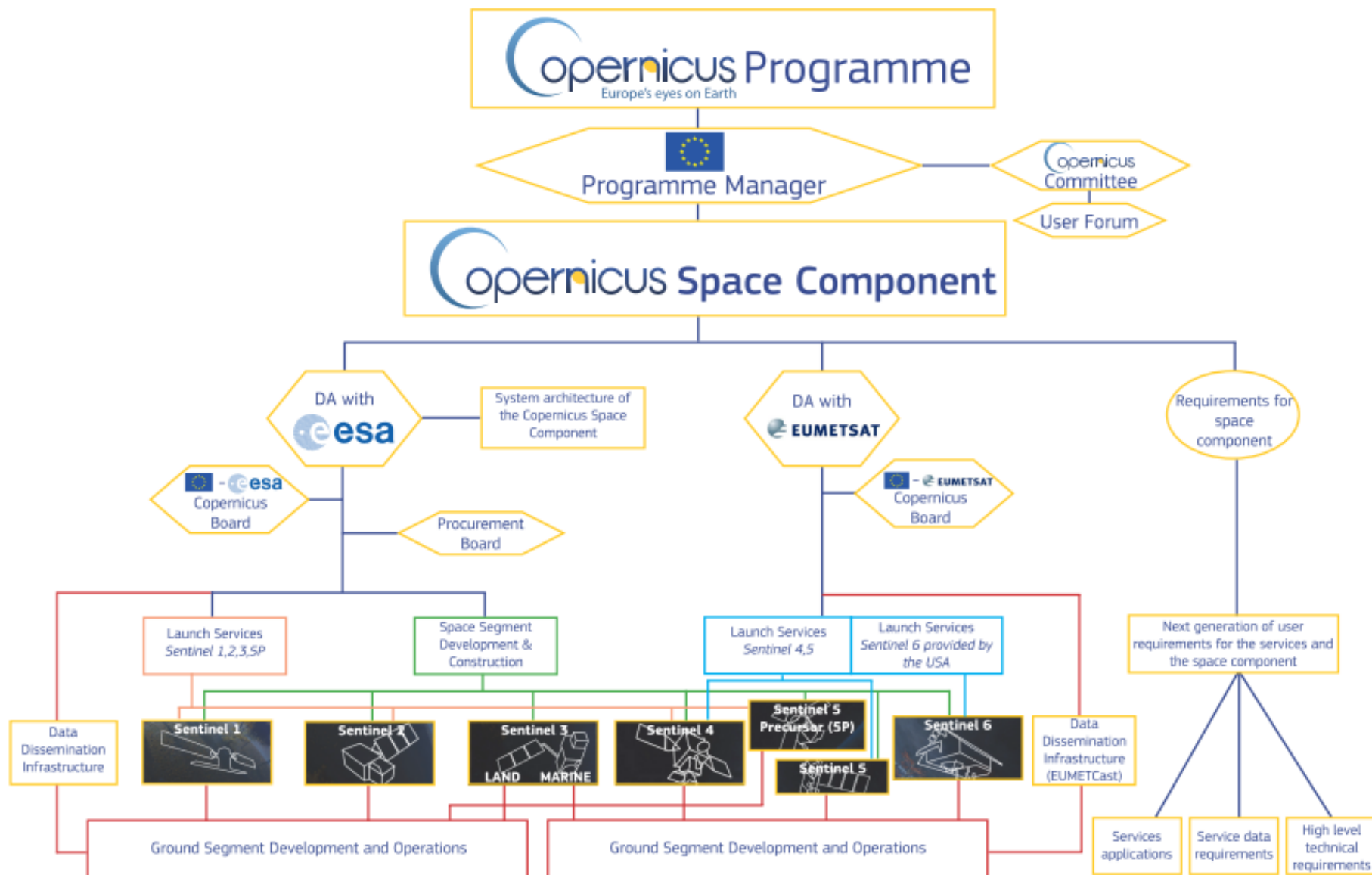
План

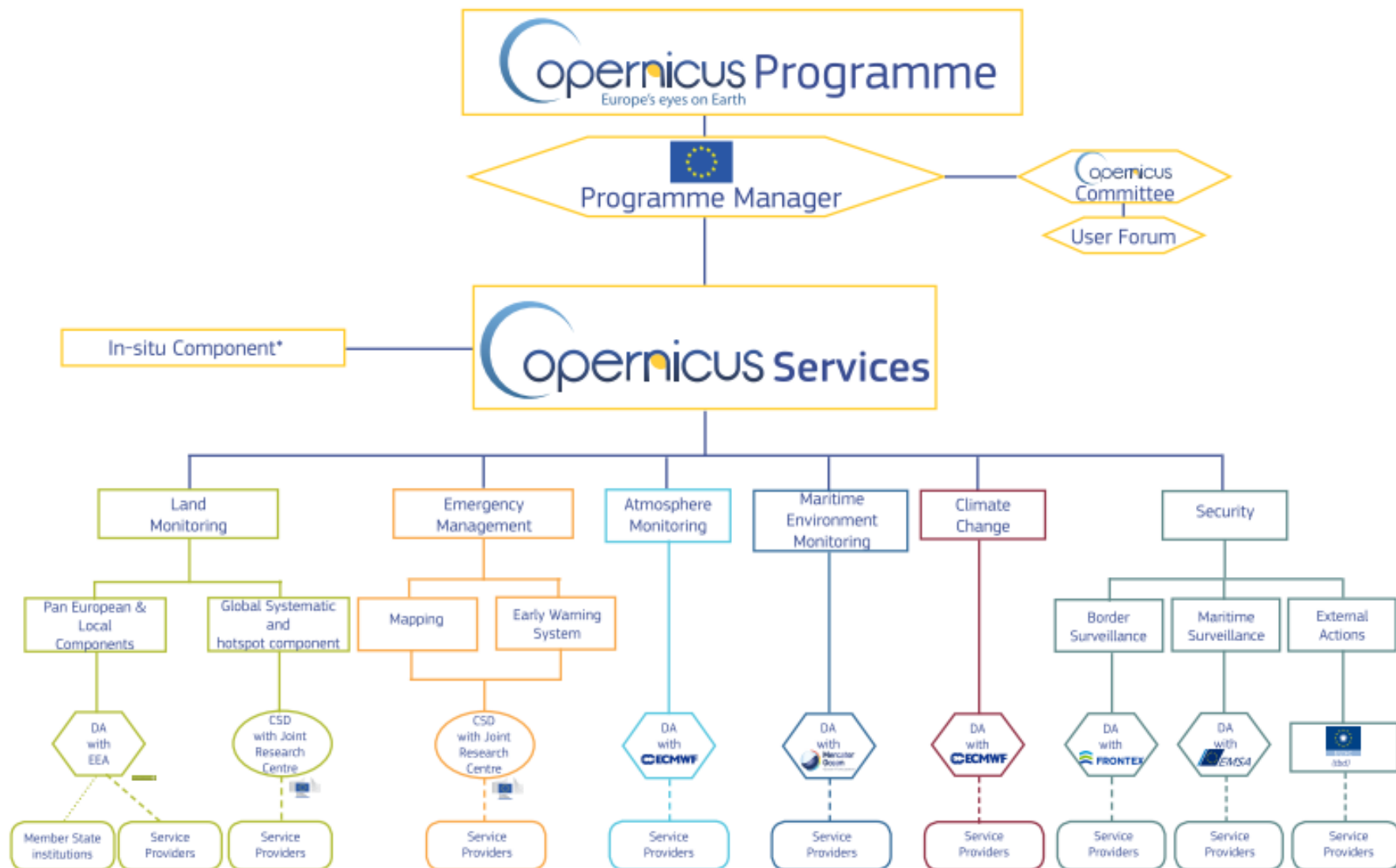
1. Цели и задачи программы «Copernicus».
2. Сервис мониторинга атмосферы.
3. Сервис мониторинга земли.
4. Сервис изменения климата.
5. Сервис безопасности.
6. Сервис управления чрезвычайными ситуациями.
7. Сервис информации и продуктов Sentinel для Арктики.
8. Космический сегмент «Copernicus».

Copernicus Programme

Europe's eyes on Earth









Atmosphere Monitoring Service



The Copernicus Atmosphere Monitoring Service is part of the Copernicus Programme, which is an EU Programme managed by the European Commission (EC) and implemented in partnership with the Member States, the European Space Agency (ESA), the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT), the European Centre for Medium-Range Weather Forecasts (ECMWF), EU Agencies and Mercator Océan. The Programme is aimed at developing a set of European information services based on satellite Earth Observation and in-situ (non-space) data.

What is the Copernicus Atmosphere Monitoring Service?

The Copernicus Atmosphere Monitoring Service provides the capacity to continuously monitor the composition of the Earth's atmosphere at global and regional scales. This service capacity encompasses the description of the current situation (analysis), the prediction of the situation a few days ahead (forecast), and the provision of consistent retrospective data records for recent years (re-analysis). The service generates geophysical products which require further technical processing and various forms of high level information

to support decision makers. The main areas the Copernicus Atmosphere Monitoring Service focuses on are:

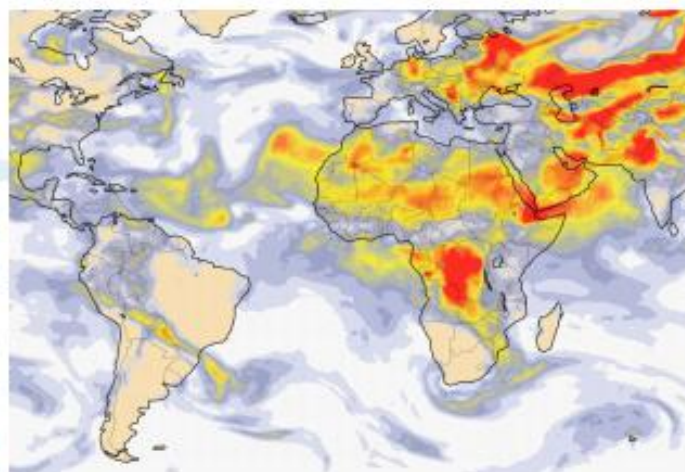
- Air quality and atmospheric composition;
- Ozone layer and ultra-violet radiation;
- Emissions and surface fluxes;
- Solar radiation;
- Climate forcing.

In November 2014, the European Commission signed a Delegation Agreement with ECMWF for the implementation of the service. The service became fully operational from July 2015.

What does the Atmosphere Monitoring Service do?

Typical products provided by the service are:

- Maps and data for regional air quality forecasts;
- Retrospective assessments of air quality;
- Identification of pollutants and their source;
- Pollen concentration levels in the atmosphere;
- Resources for evaluating possible emission control measures;
- Inputs to local air quality forecasts, health information and warnings.





Marine Environment Monitoring Service



The Copernicus Marine Environment Monitoring Service is part of the Copernicus Programme, which is an EU Programme managed by the European Commission (EC) and implemented in partnership with the Member States, the European Space Agency (ESA), the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT), the European Centre for medium-range Weather Forecasts (ECMWF), EU Agencies and Mercator Ocean. The Programme is aimed at developing a set of European information services based on satellite Earth Observation and in-situ (non-space) data.

What is the Copernicus Marine Environment Monitoring Service?

The Copernicus Marine Environment Monitoring Service provides regular and systematic information about the physical state and dynamics of the ocean and marine ecosystems for the global ocean and the European regional seas. This data covers analysis of the current situation, forecasts of the situation a few days in advance and the provision of retrospective data records (re-analysis). The Copernicus Marine Environment Monitoring Service calculates and provides products describing currents, temperature, wind, salinity, sea level, sea ice and biogeochemistry. These factors support marine and maritime applications and

related EU policies, e.g. in the fields of:

- Marine safety;
- Marine and coastal environment;
- Marine resources;
- Weather, seasonal forecasting and climate.

Mercator Ocean, the French centre for global ocean analysis and forecast has been entrusted by the EC to implement and operate the service.

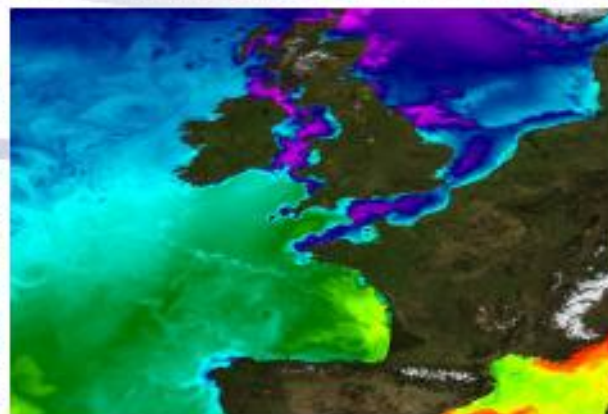
What does the Copernicus Marine Environment Monitoring Service do?

This unique service worldwide offers all

corners, freely and openly, simply and instantaneously, information on the physical and biogeochemical state of the global ocean and the six regional seas in Europe. These digital data are scientifically qualified and regularly updated.

Typical products provided by the service are:

- Maps and data for oceanographic forecasts;
- Retrospective assessments of the sea state for R&D or operational purposes;
- Simulations Ocean physical state (for drift calculations, routing, input for scenarios, site survey ...);
- Boundary conditions for coastal models.



Implementation by



Space



Who can use the Copernicus Land Monitoring Service?

Any citizen or organisation around the world can access the Copernicus Land Monitoring Service on a free, full and open access basis. This is in line with the Copernicus Programme's overall data and information policy which promotes the use and sharing of Copernicus information and data. There is no restriction on the use, reproduction or redistribution of the information and data.

The Copernicus Land Monitoring Service is free to access by any citizen or organisation in the world.



Forest: natural colour composite, bands 452 (RGB), Gölitz, Austria



How our data is being used

Europe is one of the most intensively used continents on the globe, with the highest share of land (up to 80%) used for settlement, production systems (including agriculture and forestry) and infrastructure. Conflicting land-use demands often arise, requiring decisions that will involve hard trade-offs.

There are several important drivers for land-use change in Europe:

1. Production of food and fibre
2. Production of biomass for bioenergy
3. Carbon storage in land and soil
4. The increasing demand for housing and living space per person

In addition, the link between economic activity, increased mobility and growth of transport infrastructure usually results in land take. Land is a finite resource: how it is used constitutes one of the principal drivers for environmental change, with significant impacts on ecosystems and quality of life, as well as on the management of green infrastructure.

Therefore the products and services that the Copernicus Land Monitoring Service provides are increasingly important to best manage the use of land and its impact.

Many developers have already taken advantage of the full, free and open Copernicus data to create new products and research in this important field and you can read more about these at <https://land.copernicus.eu/user-corner/land-use-cases>

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Copernicus Climate Change Service

OBSERVER: Top Copernicus images and articles from 2018

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Copernicus Security Service

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Copernicus Emergency Management Service

OBSERVER: A look into the many achievements of Copernicus in 2018!

Copernicus Sentinel-1

Sentinel-1 provides all-weather, day and night radar imagery for land and ocean services. The twin satellites Sentinel-1A and Sentinel-1B were respectively launched on 3 April 2014 and on 25 April 2016.

[Learn more...](#)



Copernicus Sentinel-2

Sentinel-2 provides high-resolution optical imagery for land services. It provides for example, imagery of vegetation, soil and water cover, inland waterways and coastal areas. Sentinel-2 also delivers information for emergency services. The twin satellites Sentinel-2A and Sentinel-2B were respectively launched on 22 June 2015 and on 7 March 2017.

[Learn more...](#)



Copernicus Sentinel-3

Sentinel-3 provides high-accuracy optical, radar and altimetry data for marine and land services. It measures variables such as sea-surface topography, sea- and land-surface temperature, ocean colour and land colour with high-end accuracy and reliability. The twin satellites Sentinel-3A and Sentinel-3B were respectively launched on 16 February 2016 and on 25 April 2018. [EUMETSAT](#) operates the satellites and delivers the marine mission, while [ESA](#) delivers the land mission.

[Learn more...](#)



Copernicus Sentinel-4

Sentinel-4 will provide data for atmospheric composition monitoring. Its objective is to monitor key air quality trace gases and aerosols over Europe at high spatial resolution with a fast (hourly) revisit time. It will be a payload embarked on EUMETSAT's Meteosat Third Generation (MTG), which is scheduled to be launched around 2019.



Copernicus Sentinel-5

Sentinel-5 will also be dedicated to atmospheric composition monitoring. It will be a payload embarked on a EUMETSAT's Metop Second Generation (Metop-SG) to be launched in 2021 timeframe. It will provide accurate measurements of key atmospheric constituents such as ozone, nitrogen dioxide, sulphur dioxide, carbon monoxide, methane, formaldehyde, and aerosol properties.

[Learn more...](#)



Copernicus Sentinel-5P

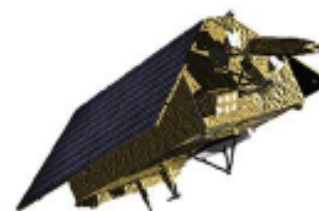
Sentinel-5 Precursor is a satellite mission launched on 13 October 2017. It is a gap filler mission aiming to provide data continuity until the launch of Sentinel-5, the dedicated atmospheric Copernicus mission, scheduled for launch in 2021.

[Learn more...](#)



Copernicus Sentinel-6

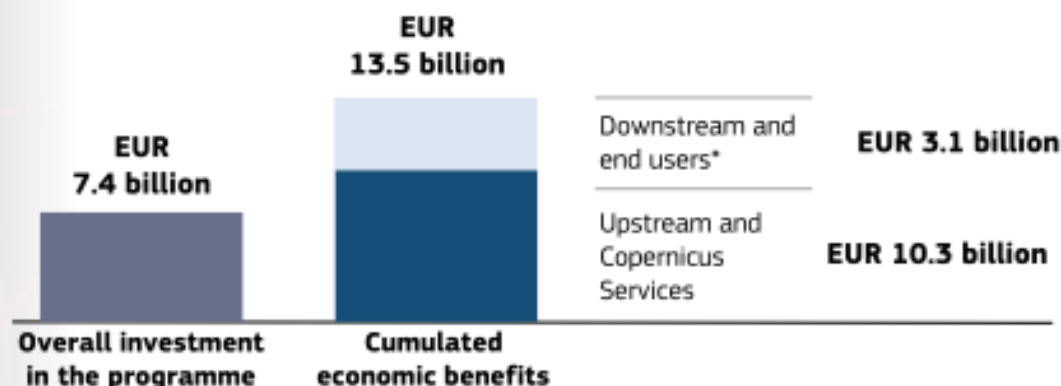
Sentinel-6 will provide high accuracy altimetry for measuring global sea-surface height, primarily for operational oceanography and for climate studies. It is a cooperative mission developed in partnership between Europe (EU, ESA and EUMETSAT) and the U.S. (NOAA and NASA). It is planned for launch in 2020.



Overview of Copernicus programme benefits

From 2008 up to 2020, the total investments in the Copernicus programme are forecasted to reach EUR 7.5 billion. Over the same period, this investment will generate a benefit of 13.5 billion (not counting non-monetary benefits). This economic value is generated through the added value created in the upstream space industry, the sales of Copernicus-based applications by downstream service suppliers and the exploitation of Copernicus-enabled products by end users in various economic sectors.

Cumulated impacts over 2008 - 2020

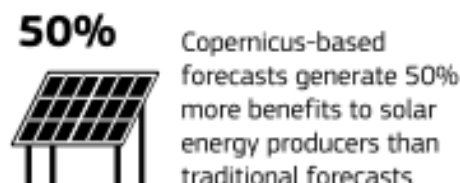
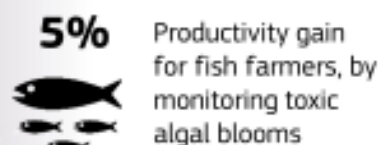
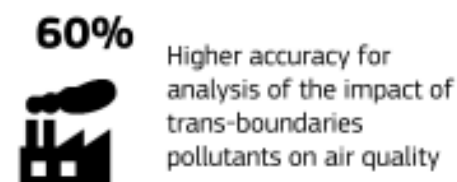
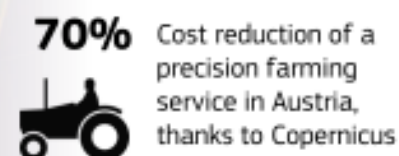


12,450 job years supported in the downstream and end user markets



15,580 jobs years supported in the upstream

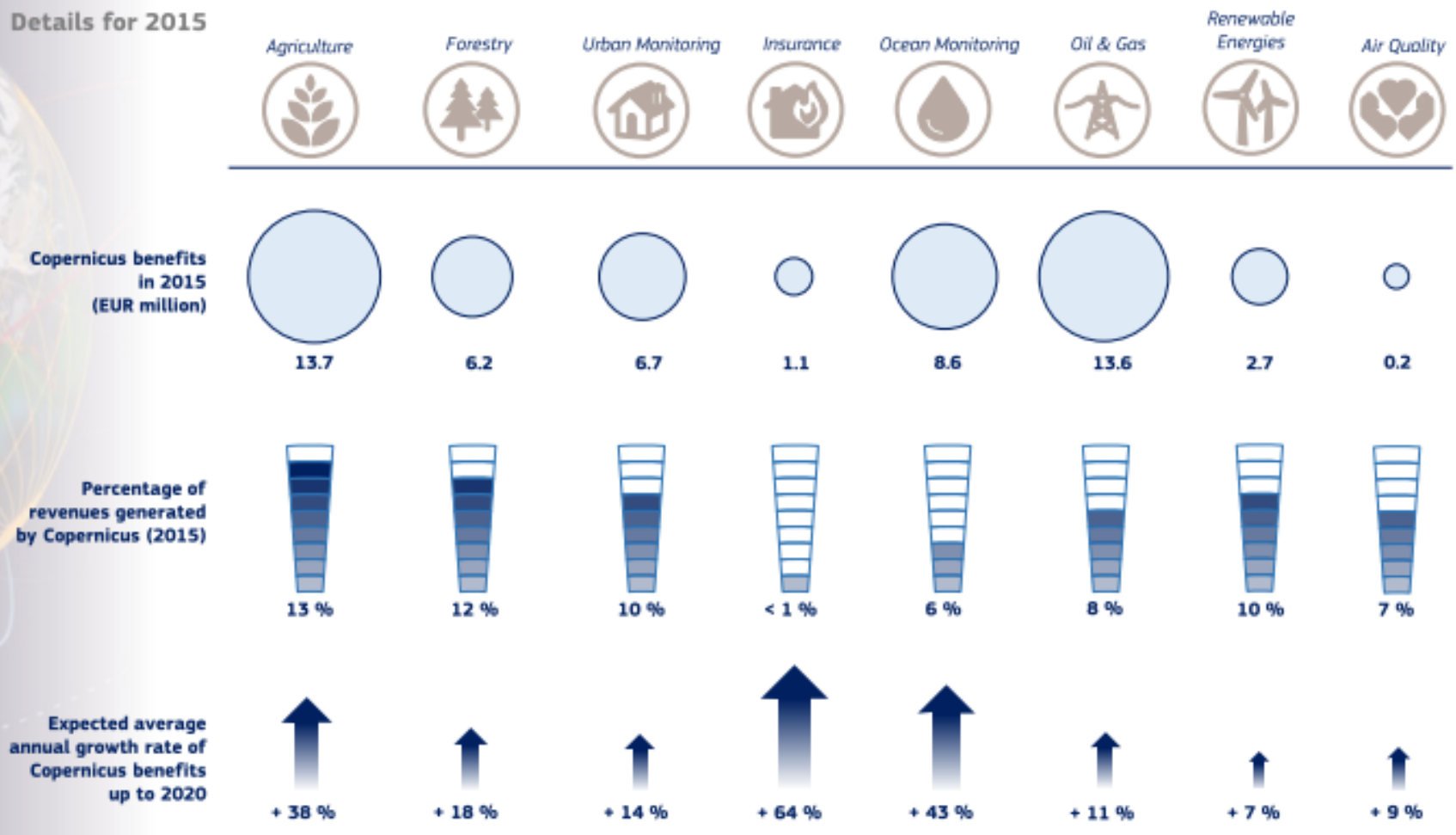
Examples of existing Copernicus benefits



* The Downstream and end user analysis includes only 8 value chains: Agriculture, Forestry, Urban Monitoring, Insurance, Ocean Monitoring, Oil & Gas, Renewable Energies and Air Quality. Estimates for end users were only calculated for Insurance, Oil&Gas and Urban Monitoring. The estimates of downstream and end user benefits should be seen as extremely conservative because they were calculated barely a year after the launch of the first Sentinel satellite. Benefits are likely to increase significantly as more Sentinels become operational and as users progressively discover the programme. In addition, the end user benefits (which are likely to be substantially larger than the downstream benefits) were only calculated for the commercial users in three value chains (Insurance, Oil&Gas and Urban Monitoring). Many user benefits are non-monetary in nature and extremely complex to quantify. The aim of this study was to have the most robust figures in order to show the existence of the phenomenon rather than providing an exact figure (to prevent overestimation of benefits).

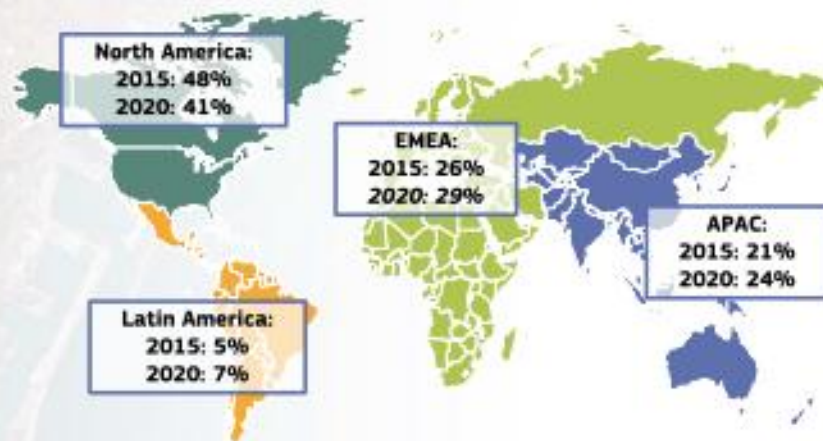
The Copernicus benefits vary between the value chains, depending on the relative size of the domain in the EO downstream market and the penetration rate of Copernicus. All the sectors considered are forecasted to witness a positive evolution of Copernicus economic impacts and some value chains are expected to experience very high growth in the coming years (particularly Agriculture, Insurance and Ocean Monitoring).

Details for 2015



Earth Observation downstream market shares

Global satellite-based EO market by geographic area 2015 – 2020
(Source: adapted from Technavio, 2015)



€ 2,751 Million¹

Global EO downstream market in 2015

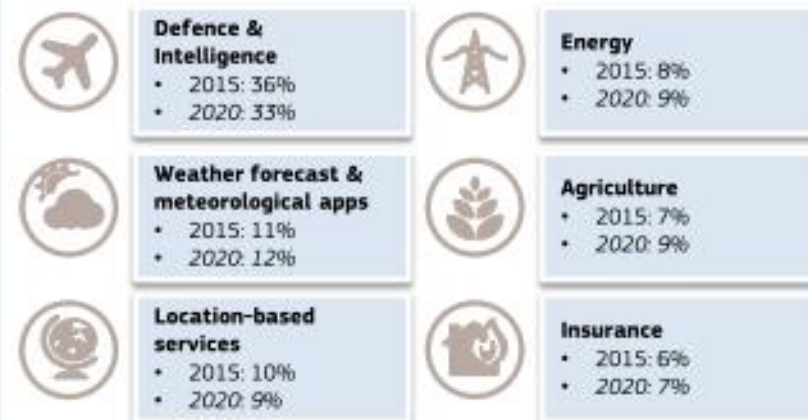
€ 632 Million¹

European EO downstream market in 2015

¹ Source: Technavio, 2015. Global Satellite-based Earth Observation Market, 2016-2020 – Conversion rate: 2015 average rate: 0.9019 (European Central Bank)

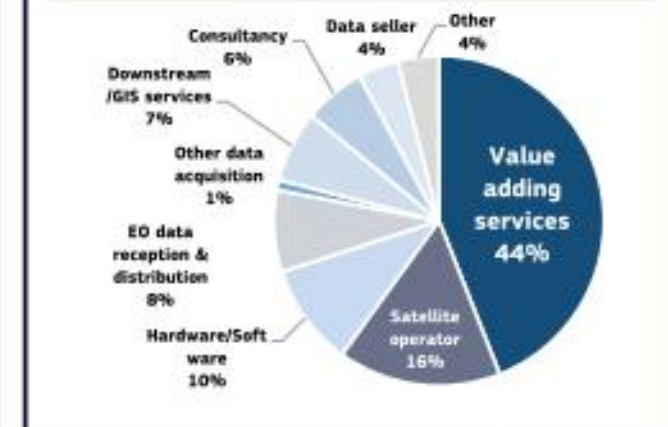
² Source: EARSC, 2015. A Survey into the State and Health of the European EO Services Industry. Prepared by EARSC, under assignment from ESA, September 2015.

Global satellite-based EO market by vertical segment 2015 – 2020
(Source: adapted from Technavio, 2015)



€ 911 Million²

European EO Services industry (midstream and downstream) in 2015



Split of European Services Industry
(Source: adapted from EARSC, 2015)

Copernicus, Europe's eyes on the Earth

Copernicus main applications areas

The Copernicus programme provides data and services that **support added value in several non-space domains**. The outputs of the programme support a **variety of applications**, potentially impacting businesses and organizations in day-to-day business and operations, and facilitating decision and policy making processes.

The present report focuses on eight promising downstream "value chains" or user segments ensembles: Agriculture, Forestry, Urban monitoring, Insurance for natural hazards, Ocean monitoring, Oil & Gas and Mining, Renewables energies and Air quality management.

Areas using Copernicus data

Agriculture

Monitoring soil moisture, surface temperature, photosynthetic activity...



Blue economy

Enhancing marine knowledge and the ocean economy

Climate change & Environment

Observing sea level rise, ice melting, temperature increase...



Development & Cooperation

Monitoring food security or desertification in collaboration with international organisations

Energy & Natural resources

Selecting production sites, facilitating exploitation, monitoring plants, networks...



Forestry

Mapping species, monitoring deforestation, illegal logging...

Health

Monitoring air quality, mapping of potential outbreaks of epidemics or diseases



Insurance & Disaster management

Preventing disasters, supporting risk modelling...

Security & Defence

Supporting external actions, peacekeeping operations...



Tourism

Planning seasonal tourism activities, contributing to the protection of natural heritage ...

Transport

Supporting air traffic, drawing shipping routes, monitoring road safety...



Urban planning

Monitoring infrastructure, construction building, urban sprawl, land change...

Overview of major areas leveraging Copernicus data and services

Copernicus revenues related to Urban Monitoring

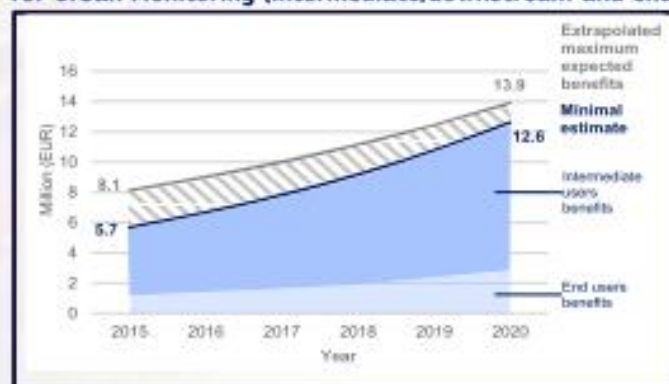
Copernicus' current enabled revenues in urban monitoring

The revenues of EO intermediate users' (i.e. downstream service providers) attributable to urban monitoring are estimated to have amounted to some EUR 45.5 million in 2015¹. According to the stakeholders interviewed, Copernicus generates minimum 10% of their revenues, leading to a conservative estimate of the **Copernicus-enabled revenues of EUR 4.6 million in 2015 for downstream providers**. To obtain a maximum estimate, we run the same calculations with the GIS market for urban monitoring and obtain a EUR 6.7 million Copernicus-enabled revenue. In addition, we follow a study from CISCO² which estimates that investment in Smart cities produces a 25% return on investment. Under such assumption, the benefits for end users (i.e. the municipalities) would represent between EUR 1.1 and 1.4 million.

Copernicus' projected contribution to global and European revenues in urban monitoring

The EO market for Urban Monitoring is expected to grow by 17% every year from 2015 to 2020. Assuming a constant share of Copernicus-enabled revenue (10%), a conservative estimate of the **expected value of Copernicus data by 2020 is around EUR 12.6 million**. This includes EUR 9.9 million for intermediate users and EUR 2.5 million of end user benefits. However, Copernicus data will likely grow in importance, notably with the operations of **Sentinel-3** is expected to provide land-surface temperature.

Current and prospective revenues enabled by Copernicus in Europe for Urban Monitoring (intermediate/downstream and end users)



Source: The report on the Copernicus downstream sector and end user benefits, prepared by PwC for the European Commission, October 2016



(in EUR million)	EO interm. users' revenues for UM	Copernicus-enabled revenues for EO interm. users	GIS interm. users' revenues for UM	Copernicus-enabled revenues for GIS interm. users
2015	45.5	4.6	66.9	6.7
2020	98.7	9.9	104.4	10.4

(in EUR million)	Conservative estimate of Copernicus benefits for end users	Optimistic estimate of Copernicus benefits for end users
2015	1.1	1.4
2020	2.5	2.6

An increase of the number of urban monitoring users is forecast in the coming years. Copernicus Climate Change Service (C3S) will soon disseminate products dedicated to cities that will enable planners to monitor the environmental impact of cities, increasing the number of users of EO data for sustainable development purposes. Sentinel-3 and Sentinel-5B data will also be key to the development of environmental applications.

¹ EARS (2015). A survey into the State and Health of the European EO Services Industry. Prepared by EARS under assignment from ESA, September 2015.

² Cisco, 2014. Smart and connected communities. Solutions for a Smart city. EMEA.



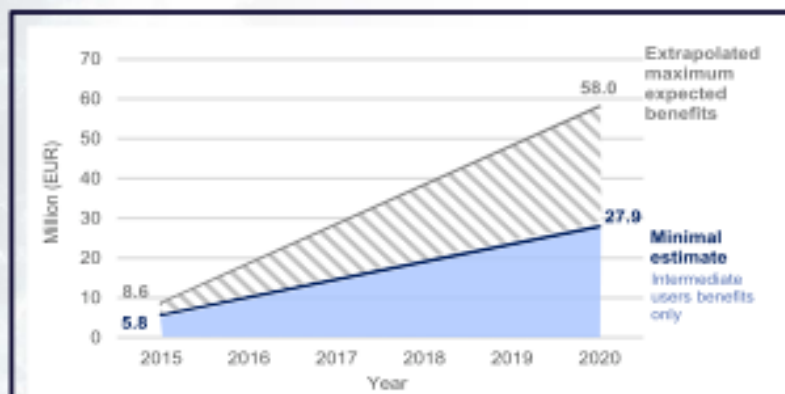
Copernicus contribution to Ocean Monitoring related activities

Copernicus current enabled revenues in Ocean Monitoring

Based on a sample of service providers covering a wide range of applications (coastal protection, marine biodiversity, support to aquaculture, mapping of marine protected resources, etc.), **Copernicus current enabled revenues are estimated to account for 6% of the intermediate users' revenues for ocean monitoring, representing EUR 5.8 to 8.6 million.** The current enabled revenues directly attributable to Copernicus may appear to be, at this stage, quite low but the study was performed only a year after the launch of the first Sentinel satellite. **The economic impact of Copernicus is expected to grow extremely quickly, up to EUR 58 million in 2020,** in particular thanks to the Sentinel-3 missions. In addition, these estimates do not include the benefits for the end users (e.g. fishermen), but only for the intermediate users (the downstream service providers).

(In EUR million)	EO interm. user revenues for OM	Copernicus enabled revenues for EO interm. users	GIS interm. user revenues for OM	Enabled revenues for GIS interm. users
2015	103.9	5.8	154.1	8.6
2020	117	27.9	243.3	58

Current and prospective revenues enabled by Copernicus in Europe for Ocean Monitoring downstream service providers



Source: The report on the Copernicus downstream sector and end user benefits, prepared by PwC for the European Commission, October 2016



The **"INDESO" programme** (Infrastructure Development of Space Oceanography) offers an integrated solution to the challenge of monitoring and sustainable management of the marine resources in the Indonesian archipelago.

The programme aims at establishing a management centre for marine resources that will enable to predict changes in fishery resources, fostering a sustainable use of marine resources in Indonesia while preventing unsustainable or illegal practices. It involves some of the major players of the downstream market such as CLS and Mercator Ocean.

More than 25 satellites provide the INDESO centre with data on a daily basis. It receives information from the Copernicus Marine Environment Monitoring Service. The centre is planning on using data from Sentinel-3 in order to measure sea-surface topography and temperature and ocean surface colour with high accuracy and reliability.

Copernicus projected contribution to the global and European revenues in Ocean Monitoring

90% of the stakeholders' interviewed have indicated that they anticipate an increase in the enabled revenues directly attributable to Copernicus, to come mainly following the launch of Sentinel-3. The **accuracy, high resolution and repetitiveness of Sentinel-3 data will allow VAS companies to gradually use it instead of private satellite data:** this will cause an **important decrease of production costs** as well as an **improvement of the quality of the products delivered.** Service providers therefore anticipate a facilitated market penetration in order to reach additional clients in a period from 5 to 10 years. The **integration of Sentinel-3 data will also foster the development of new products** to monitor marine biodiversity for example. The creation of these products will boost the competitiveness of the VAS companies and will have an impact on the distribution of the market, with a higher proportion of private users.



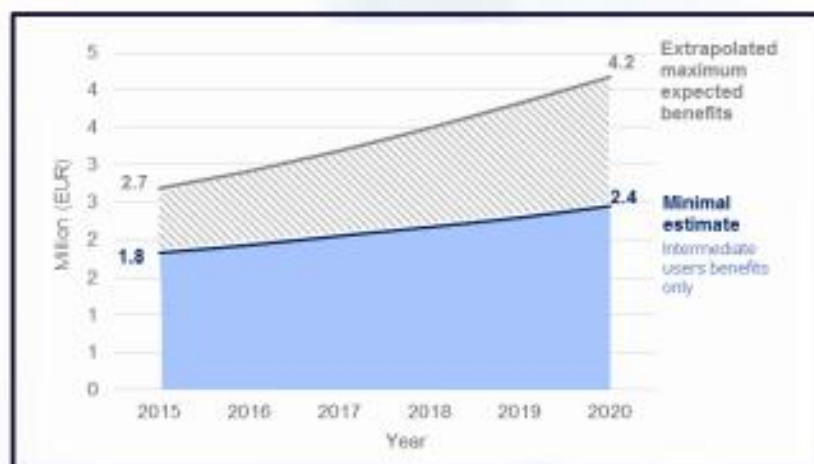
Copernicus revenues related to the Renewable Energies sector

Copernicus current enabled revenues in the Renewable energies sector

Based on a sample of EO service providers covering a wide range of renewable energy applications, **Copernicus current enabled revenues are estimated to account for 8% of the revenues of intermediate users (i.e. the downstream providers), representing EUR 1.8 to 2.7 million. This could rise up to EUR 4.2 million in 2020.** The current enabled revenues directly attributable to Copernicus may appear to be, at this stage, quite low but the study was performed at an early stage of the Copernicus programme (only one year after the launch of the first Sentinel satellite) and the estimates are voluntarily extremely conservative. In addition, these estimates do not include the benefits for the end users (e.g. the energy producers), but only for the intermediate users (the downstream service providers).

(in EUR million)	EO interm. users revenues for RES ¹	Copernicus enabled revenues for EO interm. users	GIS interm. users revenues for RES	Copernicus enabled revenues for GIS interm. users
2015	22.7	1.8	33.4	2.7
2020	30.5	2.4	52.2	4.2

Current and prospective revenues enabled by Copernicus in Europe for Renewable Energies downstream service providers



Source: The report on the Copernicus downstream sector and end user benefits, prepared by PwC for the European Commission, October 2016



¹ Source: EARS (2015). A survey into the State and Health of the European EO Services Industry. Prepared by EARS under assignment from ESA, September 2015.



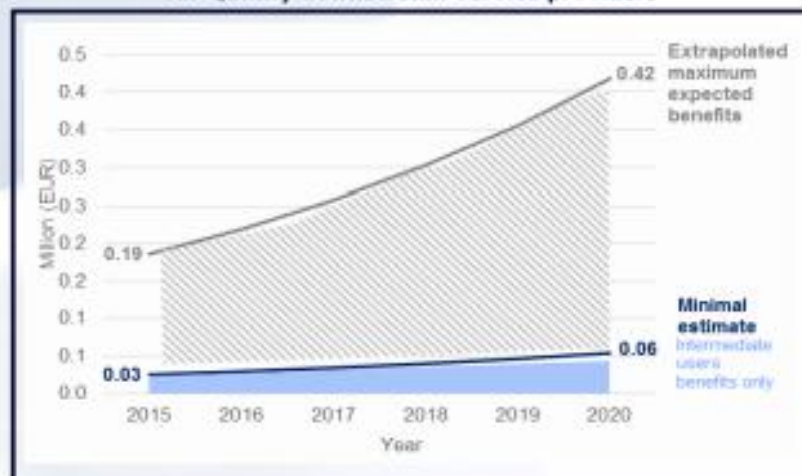
Copernicus revenues related to Air Quality management

Copernicus current enabled revenues in Air Quality management

In 2015, the revenues in the field of Air quality are estimated to be of EUR 0.36 million for EO companies. According to our stakeholder consultation, Copernicus data represents between 7% of the data used. Thus, in 2015, revenues enabled by Copernicus in the field of air quality can be estimated to be around EUR 25,000 (minimal estimate). To obtain a maximum estimate, we run the same calculation using the GIS market for Air quality as a basis (EUR 2.67 million in 2015). This yields a Copernicus-enabled revenue for the Air quality downstream service providers of EUR 0.19 million. The current enabled revenues directly attributable to Copernicus may appear to be, at this stage, quite low but the study was performed at an early stage of the Copernicus programme (only one year after the launch of the first Sentinel satellite) and the estimates are voluntarily extremely conservative.

Though they were not quantified here, benefits for end users (e.g. municipalities or citizens) also exist, linked to the impact of air pollution such as sick leaves, healthcare costs etc.

Current and prospective revenues enabled by Copernicus for Air Quality downstream service providers



Source: The report on the Copernicus downstream sector and end user benefits, prepared by PwC for the European Commission, October 2016

(in EUR million)	EO interm. users' revenues for AQ ²	Copernicus enabled revenues for EO interm. users	GIS interm. users' revenues for AQ	Copernicus enabled revenues for GIS interm. users
2015	0.36	0.03	2.67	0.19
2020	0.54	0.06	4.18	0.42

Copernicus projected contribution to the global and European revenues in Air Quality management

The Air Quality monitoring market is expected to grow at a rate of 8.5% per annum from 2016 to 2021¹, while the relative importance of Copernicus will also grow. By 2020, we estimate the Copernicus-enabled to range between EUR 0.06 and 0.42 million in 2020.

Indeed, the penetration rate of the municipalities market should rise. Then, more players are expected to buy Air Quality forecasts such as insurance companies (as input data for risk models). Air quality forecasts and Copernicus data on pollen and UV could be used in applications for health by municipalities, citizens or health mutual funds. A diversification of the geographic provenance of the users is also expected. Most of the VAS companies consulted are anticipating a significant increase of their extra-European sales of Copernicus-based products in the coming years and already have carried out operational projects in countries outside of Europe.

¹ Marketsandmarkets, 2015. Air Quality Monitoring Market by Product (Fixed Gas, Portable, Dust & Particulate Monitor, AQM Station), Pollutant (Chemical, Physical, Biological), End User (Government, Commercial & Residential, Petrochemical, Pharmaceutical) - Forecast to 2021

² Source: EARSCE (2015). A survey into the State and Health of the European EO Services Industry. Prepared by EARSCE under assignment from ESA, September 2015.